UNITED STATES UTILITY PATENT APPLICATION

OF

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FOR

GOLF CLUB HEAD WITH INSERTS FOR IMPACT FACE

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Attorney Docket No.003534-106

GOLF CLUB HEAD WITH INSERTS FOR IMPACT FACE

Field of the Invention

[0001] The invention relates to improvements in construction of golf club heads and faces for golf clubs such as a driver, iron or putter.

Background of the Invention

[0002] Improving the control and feel of the impact of a golf club face with the ball is the goal of many in the art of golf club design. Of the many proposed solutions, several may work to control the impact performance but do not conform to the USGA Rules of Golf that limit the impact face of a club to a single material and also specify the geometry of grooves.

[0003] Grooves are used on virtually all impact faces on iron type clubs and many wood type clubs to improve performance in wet conditions or conditions laden with debris. Grooves provide a space for contaminates to move out of the way allowing the ball to contact the club face and also function to impart spin to the ball for increased loft, straighter flight, and to control roll after landing. Precision grooving of the impact face is a costly process; more so if the material is a difficult to machine alloy such as titanium and even more so for NiTi materials which are very difficult to machine by standard methods. Grooves can be cast into the face of a club but the dimensional precision of the groove is compromised since the casting process cannot give sharp radii and tight dimensional tolerances.

[0004] A large variety of materials have been proposed, and in fact used and offered commercially as golf club heads and their impact faces. These materials have been used to construct the head as a whole or as inserts in the club face in an attempt to achieve greater distance, more control over

the ball, or a desirable "feel" at impact. The list of materials includes polymers, ceramics, and metals, shape memory materials such as NiTi based and copper based alloys, and most commonly, stainless steels, BeCu, and lately various titanium alloys. The typical approach taken to control the performance of the impact face of a club has been to change materials from the standard steel face for irons and putters to lower modulus materials like Titanium 6-4 or Beta Titanium alloys or to steel alloys that can withstand higher deformation than the standard steel alloys

[0005] Each of these materials has individual properties, different from each other but basically uniform unto themselves and provide a surface on a golf club that impacts the golf ball with essentially uniform mechanical properties across the face. For example, a typical titanium alloy such as Titanium 6-4 has a modulus of about 15 million psi and a yield strength of about 120,000 psi at a strain of less than 1%. Other materials will have different moduli, different yield strengths with different associated strain levels and thus produce different albeit uniform results upon impact with a ball.

[0006] Since the mechanical characteristics (club speed, materials properties, geometry) at the impact of the club face with the ball determine the flight (trajectory, distance, dispersion) of the ball; control of the materials properties can be key to control of the flight of the ball. With club head material, geometry, and speed held constant, it is known for example, that thinner faces tend to hit the ball further but on the other hand thinner faces are more easily deformed by hard impacts with the ball or other foreign objects like rocks. For this reason, materials such as Beta Titanium are sometimes employed which allow recovery from greater deformations on impact. NiTi

alloys (as in U.S. Patent No. 5,176,384) allow even greater deflections in thin face inserts without deformation.

[0007] The most common type of striking face insert is composed of a single piece of material and therefore has a "trampoline" geometry. The "trampoline" geometry provides a centroidal sweet spot but away from this zone performance drops off quickly. In U.S. Patent No. 5,807,190, individual elements called pixels are provided on the face of the club to improve the uniformity of response to off-center hits. The pixel inserts de-couple the shear forces that would occur in a monolithic face or monolithic face insert thus providing a more uniform response much like an individual coil spring mattress would do versus a trampoline. This patent also discloses solid striking face inserts treated to provide pixel zones of differential impact response. U.S. Patent No. 6,007,435 discloses a plurality of substantially square rods of high-hardness material (harder than tungsten carbide) bonded together and mounted in an open chamber to form a golf club head striking surface. While employing individual elements, this patent discloses a way to construct a very hard striking face for a high reactive force and does not suggest an approach to controlling the impact response across the impact surface. In U.S. Patent No. 5,542,675 an adapter is provided which covers the face of a putterhead and provides a striking surface of elastomeric material. In one embodiment of this patent, the striking face of the removable putterhead adapter comprises a series of elastomeric strips mounted on the striking face and separated by a distance which leaves a groove between the strips.

[0008] U.S. Patent No. 5,405,136 discloses a golf club head face insert designed to counter the effect of off-center hits by varying the hardness of the striking surface from the center outward. This is accomplished

primarily by constructing the insert of concentric circular or elliptical rings. Although, varying the thickness of insert material and constructing the insert of vertical strips of material of varying hardness are also disclosed.

[0009] U.S. Patent Nos. 1,383,654, 1,452,695, 1,494,494, and 1,646,461 disclose various plug inserts and means for retaining and shaping inserts for golf club heads. In U.S. Patent No. 5,766,093 a putterhead is provided with a plurality of vertically oriented non-contiguous striking plates or adjacent vertical striking plates of different materials for the purpose of providing a variable response as a function of the distance from the intended strike point. In U.S. Patent No. 5,358,249 a golf club head is disclosed which includes a plurality of elongated strips of insert material in spaced-apart inserts where the grooves of the club face are provided in the club head base material between each adjacent recess. The designs disclosed in these patents do not appear to provide a striking surface of uniform material as required by the USGA Rules of Golf, Rule 4 and Appendix II.

[0010] Furthermore, none of the patents described above provides an improvement in the economical production of precision machined grooves in golf club heads.

Summary of the Invention

[0011] The invention provides a faceplate for a golf club (putter, iron, or driver), particularly for iron type clubs incorporating individual matched bars into an impact face. The composition, design and arrangement of the bars allows for fine control of the impact response of the striking surface at positions across the insert. The adjacent side edges of the bars may be formed to provide precision grooves. This allows individual bars to be economically mass produced before being inserted into the face of a club. The bars can be

retained in the club face by virtue of a dovetail geometry on the ends of the bars. In a preferred embodiment, the grooves are formed by machining the appropriate side edge of each bar into a half groove whereby when the bars are assembled as a faceplate, the adjacent half grooves form a series of grooves across the faceplate. In a preferred embodiment, a top and/or bottom retainer element is pressed into place in the dovetail locking the bars into position.

[0012] The fundamental object of the invention is to provide a desirable feel and larger "sweet spot" for a golf club. An additional object of the present invention is to enhance performance by providing a desired balance between maximized distance and control. A further object of the invention is to provide improved uniformity of response upon impact for off-center hits and to reduce the effect of off-center hits on the path of the struck ball. A further object of the invention is to provide this enhanced "feel" and performance of a golf club while conforming with the USGA Rules of Golf with respect to uniformity of material and geometry of markings, i.e., grooves, on the impact surface. A further object of this invention is to provide a more economical method to manufacture grooves in the face of a club.

[0013] These advantages and others which will become apparent may be further understood by reference to the drawings and descriptions of details and examples set forth below.

Brief Description of the Drawings

[0014] FIG. 1 shows schematically an exploded view of a golf club head incorporating a plurality of bars in accordance with the invention.

[0015] FIG. 2 shows a detail section view of the edge of the striking face recess of FIG. 1 at area II including a dovetail mating surface.

[0016] FIG. 3 shows a detail view of two adjacent bars in cross section.

[0017] FIG. 4 shows an example embodiment of an assembled "bars" iron.

[0018] FIG. 5 shows a cross-section through the line V-V of FIG. 4.

[0019] FIG. 6 shows a cross-section through the line VI-VI of FIG. 4.

[0020] FIG. 7 shows an expanded view of two bars in area VII of FIG. 6.

[0021] FIGS. 8-10 show exemplary alternative embodiments according to the invention wherein the bars are "V" shaped.

[0022] FIGS. 11-12 show two exemplary "V" shaped bars.

[0023] FIGS. 13-14 show alternative embodiments wherein the bars are inserted by a relieved end slot and retained by a single press-fit bar.

[0024] FIGS. 15-16 show an example of a multi-layer bar in two views in accordance with the invention.

[0025] FIG. 17 shows, in detail, a bar end design according to a preferred embodiment of the invention.

[0026] FIGS. 18-22 show various exemplary bar end sections in perspective wherein the bar thickness may be varied across the width of the bar according to the invention.

[0027] FIGS. 23-28 show various exemplary bars in accordance with the invention wherein the bar cross section may be varied along the long dimension.

[0028] FIGS. 29-31 show in cross section several exemplary embodiments of iron type clubs according to the invention incorporating stacked bars of varied thickness.

Detailed Description of the Invention

[0029] The invention provides a faceplate for a golf club head which incorporates a plurality of individual bars. This allows the mechanical properties of the striking surface of a golf club to be controlled and varied across the surface and provides an economical arrangement for manufacturing a precision grooved surface of the striking face.

[0030] Referring for example to FIGS. 1-14, the club head body 1,21,31,42 may be made of any material suitable for the construction of golf clubs and may include additional features such as a sole-plate on wood type clubs as are known in the art. The club head body 1 has a recess 2 in the club striking face 3,23,33,45 and optionally a cavity 4,24 or through hole within the recess, in the vicinity of the impact point. A plurality of machined or otherwise formed bars 8,28,39,40,48,49 are fit contiguously into the recess in the face of the club head to form the striking surface of a faceplate for the golf club head. The bars have three primary dimensions, length, width, and depth, with a frontwall 13 bounded by the two largest dimensions, length and width, sidewalls 12 bounded by the length and depth, and endwalls bounded by the width and depth. The depth dimension may be uniform or variable lengthwise as may the thickness of the material. Each endwall 11 may comprise a single surface which is perpendicular or angled with respect to the frontwall, e.g., the endwall can be shaped to form an interlocking surface which can engage a surface 5,25 cast or machined into the edge of the recess in the club head body thereby retaining the bars in the recess. The bars are preferably assembled in

the recess with the sidewalls 12 in contact with each other whereby the bars can be individually deformed in a direction perpendicular to the striking surface upon impact with a golf ball. The frontwalls may be polished or treated mechanically or chemically to provide a textured striking surface. The bars may fill the recess or be bordered by retainers which can be shaped to match the unfilled portion of the recess. If desired, a cavity may be provided beneath the bars, or the backside of the bars may be partially exposed through an opening in the rear surface of the clubheads.

[0031] The side edges 6 of the bar's frontwalls 13 may be machined before assembly such that a groove 10,26 is formed between adjacent bars and/or between the bars and any retainers 7, 9, 27,29,34,35,44,47. A bar 37,48 side edge may be machined to provide a full length groove between adjacent bars. Alternatively, the bars 38,49 may be machined before assembly to provide a less than full length groove between adjacent bars. The bars may also be machined to form grooves in the frontwalls between the edges. The groves may be any shape (e.g., V shaped, square, or round); although, the V shaped grooves formed by two adjacent beveled edges are preferred. This allows for the economical production of precision machined grooves on a golf club face.

[0032] The bars may be retained in position in a club head by an interlocking arrangement, by bonding such as metallurgical or adhesive bonding or a combination thereof. For example, the bars may be retained in the club face by mating edges 5 forming a dovetail or other suitable geometry cast or machined into the recess 2 in the club head, e.g., spaced apart vertically or horizontally extending mating surfaces at opposed edges of the recess. In a preferred embodiment, the assembly of a "bars" iron is as illustrated in FIGS. 1-3, a dovetail slot at opposed ends of a recess is

machined into the heel 15 and toe 14 of the club head face 3. A bottom retainer 9, shaped at the bottom edge 19 to match the geometry of the bottom 17 of the club and having an interlocking surface at each end shaped to engage the dovetail slot, is press fit into the bottom of the dovetail. Typically six to eight bars 8 with the adjacent edges 6 machined at a 45 degree angle to a depth of 0.01 to 0.02 inches are stacked tightly in the dovetail slot. A retainer 7 shaped at the top edge 18 to match the geometry at the top 16 of the club head and having an interlocking surface at each end shaped to engage the dovetail slot is press fit into place above the stack securing the bars in position.

[0033] As illustrated in FIG. 4, a bars iron may present the appearance of a conventional iron with horizontal grooves 26 formed at the contiguous edges of adjacent bars 28. The club head body 21 is connected to a shaft 22 in the manner well understood in the art. The top and bottom retainers 27,29 may be of material similar to the body or may be chosen for aesthetic or mechanical properties. As seen in sectional views (FIGS. 5-7), the bars 28 are backed by a small cavity 24 to permit deflection of the bars upon impact. The mating of the angled bar ends with the dovetail slot 25 at the edges of the recess securely retains the bars in the club head body.

[0034] A further feature of the "bars" approach to providing an impact surface insert for a golf club is that the bars can be of any desirable material. For example, in putters it is desirable to achieve a soft feel so a polymeric material with a low modulus of elasticity may be selected for the bars. In an iron type club a highly elastic material with a non-linear modulus like NiTi may be selected for its ability to absorb and recover from high energy impacts. In a wood type club, materials of the highest hardness may be used to maximize flight distance.

[0035] The mechanical properties and grooving of the striking face may be controlled by varying the length, width, and arrangement of the bars. The bars may be rectilinear (i.e. straight) as in FIGS. 1,4,13-14 or shaped with a curve or bend as illustrated in FIGS. 8-10. Straight bars may be arranged to extend horizontally as in FIGS. 4,13 vertically as in FIG. 14, or at an angle relative to the plane of the ground when the club head is properly swung. As seen in FIGS. 8-10, "V" shaped bars 37-41, which may be symmetric 39,40 (FIGS. 8-9) or asymmetric 41 (FIG. 10), may be assembled in a V-down (FIGS. 8,10) or V-up (FIG. 9) chevron pattern. As illustrated in FIG. 10, retainers 35 may be secured by pins 36.

[0036] As illustrated in FIGS. 13-14, a retaining dovetail recess need not open to any one side, top, or bottom, of the club head face 45, rather bars 48,49 may be inserted via a relieved end slot 43 and retained by a press-fit or pinned final retainer bar 44, 47. Vertical bars, as illustrated in FIG. 14 may be chosen to be uniform or vary in thickness and/or width towards the toe and heel. Thicker bars at outer ends of the club face may be used to provide hook and slice correction.

[0037] As illustrated in FIGS. 15-16, the bars may be formed of uniform material or of laminated layers 52,53,54. Laminated bars 50 may be designed to combine various material properties such as a hard surface with vibration damping, and shape memory. For example a beta titanium front surface layer 52 may be machined with groove forming indentations 55. This provides the surface with high hardness, abrasion resistance and good strain recovery. This layer 52 may be bonded to a second layer 53 of polyurethane elastomer to provide vibration damping. A third layer 54 of super-elastic NiTi provides the bar 50 with a high degree of strain recovery from deformation and further vibration damping. As another example, thin layers

of stainless steel or Beta Titanium may be laminated to provide a bar capable of much higher deformation without permanent damage. Such a bar will maintain contact with the ball longer for energy transfer and enhanced transfer of spin upon impact. Any number of layers may be laminated to form a single bar. The layers may or may not be the same thickness. The front surface layer of all the bars can be of the same material across a striking face to satisfy present USGA rules.

[0038] As illustrated in FIG. 17, in a preferred embodiment of the invention, a bar 61 endwall is angled to form an interlocking surface which can engage the dovetail geometry of the spaced apart edges of the striking face recess. The top may be machined at the side-edge to form a half-groove 62. Preferably, a small chamfer 168 at the tip of the dove-tail wedge allows the bars to be more easily assembled in the striking face recess and allows greater flexure of the bars at impact.

[0039] As illustrated in FIGS. 18-22 the bars 61,161 may have a uniform thickness (FIG. 18) or varied thickness across the width of the bars (FIGS. 19-22). The cross section thickness may vary linearly 162 or non-linearly in concave 164, convex 165, or stepped 166 shapes. The bar ends 163 are preferably the full uniform thickness in order to engage the club head body at the edges of the striking face recess. Groups of such bars may be chosen for example to vary the thickness profile across the stack as illustrated in FIGS. 29-32.

[0040] As illustrated in FIGS. 23-28 the bars 61,63,66,67,68 may have a uniform (FIG. 23) or varied thickness (FIG. 24-28) lengthwise linearly or non-linearly. Thinner bars will feel softer and provide a larger zone of uniform response than thicker bars. A bar with a thinner center 67,68 will exhibit a larger sweet spot and directional correction for off center impacts. A

continuous curve 68 provides a uniform stress distribution across the face while a stepped profile 67 creates discrete zones of response. A bar with a thin profile except a central bump 63 will provide a softened feel with controlled face deformation while retaining a stiff follow-on for distance. A bar with thin outer sections 66 reduces harsh feel of toe and heal impacts. A bar with an asymmetric thickness profile 64 will provide asymmetric response to impact. The thicker end of the bar will be stiffer, thus a golf ball is directed toward the thinner bar end. This design may be used for correction of a chronic hook or slice. Similar considerations apply to the design of stacks of bars such as illustrated in FIGS. 29-32. By application of these principles in choosing and stacking bars in a club face, many different golf ball impact responses can be achieved.

[0041] The invention can be implemented in variations of the foregoing embodiments. For example, the length and direction of the bars could be varied as well within a single club face and/or a configuration of variously treated short bars could be bonded to backing bars and/or provided with mating surfaces in adjacent endwalls. Further, bars of uniform but differently processed (i.e. heat treated) material may used to provide a more even impact response across a striking face and/or smaller bars might be used to heighten this effect, e.g., short bars may be machined to provide mating surfaces at the end walls. Alternatively, short bars may have flat end walls and rely solely on adhesion to a backing bar for retention in the club head. The directions of bars may change one or more times across the club face. In arrangements of this type, the adjacent endwalls and sidewalls of orthogonal bars may be shaped to provide mating surfaces to retain bars not in contact with the edges of the recess. Bars of mixed shape and orientation may be combined in various arrangements to provide desired properties such as

differing groove and surface deformation directions as a function of striking position on the club face. Multiple layers of individual bars may be inserted in a club face recess, e.g., an outer layer of bars may be retained in the recess over a backing plate comprising an inner layer of backing bars to provide a fine tuned surface response. The exposed layer may be of a thin, uniform, and elastic material such as NiTi. Backing layers may be of any hardness, cross-section, and arrangement. In a preferred embodiment, the surface bars mate with edges of the recess for purposes of retention.

[0042] A further advantage of the invention is the ability to provide a more uniform response to off-center hits. This can be accomplished with the "bars" approach by varying the thickness of the material of the bars over the face. Also, the mechanical properties may vary at different points in the striking surface while presenting a uniform material surface. For example, bars heat-treated or otherwise processed in different ways either uniformly lengthwise or variably along a bar's length would allow the face to be fine tuned for its response characteristics. Multi-layer bars may incorporate several laminations of different materials specifically chosen for vibration dampening properties or elastic response or both. The various configurations of shape, orientation, and thickness of can be used to offset inherent imbalance and inertia effects in a club when hit off-center or to help compensate an inherently faulty swing. The back-face of the bars may comprise structural features such as a bump or island for the purpose of limiting the travel of a deformed bar upon impact with a ball.

[0043] Any of the previous examples might be used in conjunction. For example, alternating layers of vertical and horizontal bars might be used to fine tune the response of the striking surface. Likewise, any other

combination of the exemplary designs might be implemented varying the thickness, width, length, material, properties, and direction.

[0044] In addition to the forgoing description, the invention and preferred embodiments thereof may be further understood by consideration of the following examples.

Examples

Iron with enhanced off-center impact response.

[0045] Any of the long (i.e., irons numbered 1 to 5) type clubs may be enhanced for distance with consistency of control by providing a striking face with a larger area of uniform impact response. To this end, a club head body is provided with a recess in the form of a vertical dovetail slot in the face. A polished steel retainer, flat on top with the top front edge machined at a 45 degree angle to a depth of 0.02 inches, contoured on the bottom to match the bottom and sole of the club face, and machined into a dovetail wedge at each end, is press fit into the bottom of the dovetail slot. A series of 10 NiTi bars, about 0.13 inches wide, machined to a 10 degree angle at each end (with a 0.015 inch 45 degree chamfer at the wedge tip) are sized to fit snugly in the dovetail slot. The bars are about 0.1 inches deep at the ends of the frontwall. The side-edges of the front wall are machined at a 45 degree angle to a depth of 0.02 inches. The back side of each bar is machined in a parabolic contour lengthwise with the center of the 6th bar machined to approximately half its depth; upper bars are machined more deeply than lower bars in sequence step-wise such that a rear view of the bars stacked in order shows a smooth parabolic contour along the heel to toe direction of the bars and a step-wise linear progression from top to bottom of the stack. The bars are stacked

tightly together in the slot forming a precision V shaped groove at each adjacent edge. A top retainer of polished steel, flat on the bottom with the bottom front edge machined at a 45 degree angle to a depth of 0.02 inches, contoured on the top to match the top of the club face, and machined into a wedge at each end to fit tightly in the dovetail slot, is press fit into the top of the dovetail slot. In an on-center impact, the shaped impact deformation focuses energy otherwise dispersed across the face to a center line of thrust. In the case of a slightly off-center impact the shaped deformation of the face re-focuses the flight of ball in the intended direction with minimal loss of distance. The top to bottom thickness progression smooths and expands the sweet spot vertically for high and low impacts. Balls struck at the bottom of the impact face are increasingly directed upward to the desired loft and balls struck near the top of the club have a softer feel and longer contact time with the face of the club.

<u>Irons with enhanced spin and directional control</u>

[0046] An iron type club is provided with an insert of pointing "V" shaped bars as illustrated in FIG. 8-10. The V shape of the bars and grooves control the spin imparted to a golf ball upon impact. Upward pointing V bars (FIG. 8) impart top-spin. Top-spin may be desired to keep a ball's trajectory low, for example when hitting against the wind, and to increase forward fairway bounce and roll. Downward pointing V bars (FIG. 9) impart back-spin. Backspin may be desired to increase aerodynamic lift of a ball in flight or to limit a ball's forward roll in chip-shots. The V shaped bars are inherently stiffer near the heal and toe, thus directing a ball hit on the heel or toe of the club toward center. An asymmetric chevron can be arranged to stiffen the toe or heel thus selectively shifting the sweet-spot.

[0047] The various illustrations demonstrate the potential to change properties across the club face while still conforming with the one material constraint of the USGA rules. Numerous alternative arrangements, bar treatments, shapes, materials, and retaining arrangements may be imagined.

[0048] The forgoing has described the principles, preferred embodiments and mode of operation of the present invention. However, the invention should not be construed as being limited to the particular embodiments discussed. Thus the above-described embodiments should be regarded as illustrative rather than restrictive, and it should be appreciated that variations may be made in those embodiments by workers skilled in the art without departing from the scope of the present invention as defined by the following claims.